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[Title of the Invention] Injection method and apparatus of radioactive liquid

[Abstract]

[Problem]

To measure the administration dose easily and accurately while decreasing the exposure dose to a handling person.

[Solving Means]

Whole quantity of radioactive liquid is temporarily held in a radiation shielded medicine retainer 30 immediately before injection, and the radiation dose of the radioactive liquid held in the medicine retainer 30 is measured, and the whole quantity of radioactive liquid is injected into a human body.

[Claims]

1. An injection method of radioactive liquid for injecting radioactive liquid into a human body, comprising the steps of:

   holding the whole quantity of radioactive liquid temporarily in a radiation shielding liquid retainer immediately before injection,

   measuring the radiation dose of the radioactive liquid held in the liquid retainer, and

   injecting the whole quantity of the radioactive liquid into the human body.

2. An injection apparatus of radioactive liquid for injecting radioactive liquid into a human body, comprising:

   a liquid retainer for holding the whole quantity of radioactive liquid temporarily immediately before injection,

   radiation shielding means for shielding the liquid retainer,

   radiation measuring means for measuring the radiation dose of the radioactive liquid held in the liquid retainer, and

   liquid pushing means for injecting the whole quantity of the radioactive liquid after measurement of radiation dose into the human body.

3. The injection apparatus of radioactive liquid of claim 2, further comprising radiation shielding means for shielding the radioactive liquid pushing means for feeding the radioactive liquid into the liquid retainer.

4. The injection apparatus of radioactive liquid of claim 2 or 3, wherein all means are mounted on a movable carriage.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to injection method and apparatus of radioactive liquid, and more particularly to injection method and apparatus of radioactive liquid for injecting radioactive liquid into a human body preferably used when administering a radioactive medicine with a short half-life and labeled with a strongly radioactive nuclide to a subject.

[0002]

[Prior Art]

In laboratories in hospitals and other institutions, when administering a radioactive medicine with a short half-life and labeled with a strongly radioactive nuclide to a subject,

an appropriate mechanism is needed to prevent a handling person from exposure to radiation, and to administer a specified dose accurately at a specified speed, and an automatic and remote control system is thus required. For this purpose, various apparatuses for administering a radioactive medicine automatically to a subject are developed and used such as MR contrast medium injection apparatus and radioactive medicine automatic injection apparatus.

[0003]

Such injection apparatus basically comprises a syringe filled with a specified volume of medicine liquid, a tube connecting to a subject, an injection syringe for filling the tube with distilled water for injection or physiological saline, or pushing in the final portion for administering the whole quantity of chemical solution, an automatic or manual valve for changing over liquid flows, operating mechanism for administering at a specified rate, a controller, and others.

[0004]

Using the injection apparatus having such mechanism, when administering a medicine such as 15O-water or 11C-methionine or 18F-FDG (fluorodeoxyglucose) labeled with short-life nuclide (for example, having half-life of 2 minutes in 15O, 20 minutes in 11C and 110 minutes in 18F as positron releasing nuclide) to a subject, conventionally, the radiation dose was measured with the syringe filled with medicine before administration, the radiation dose remaining in the syringe was measured again after administration, and the radiation dose in the period of administration (reference time) was determined by radioactive decay correction, and thereby the radiation dose administered to the subject was measured.

[0005]

Usually, in a chemical solution vial, the concentration is known, and in order to obtain a desired radiation dose, a determined volume obtained by calculation is sucked in. In this case, if not using a vial, a specified volume of medicine liquid can be injected from other device. Anyway, since the syringe sucking a specific volume must be measured accurately, usually, the syringe contained in a lead container is taken out, and put back into the lead container after measurement, and carried to a place of subject in the laboratory, and attached to the apparatus, and after administration, the radiation dose remaining in the syringe is measured again, and the administration dose is determined.

[0006]

[Problems that the Invention Is to Solve]

Therefore, the radiation dose must be measured accurately twice, before administration and after administration, and it takes much time and labor, and the subject is also exposed to radiation when measuring the radiation dose contained in the syringe. Still more, since the syringe is measured after administration, the subject is exposed to radiation, and there is a risk of adhesion of the administration liquid to the subject's body.

[0007]

The invention is devised to solve the problems of the prior art, and it is an object thereof to measure the dose of radioactive medicine or radioactive compound labeled with short-life nuclide easily and accurately while reducing the radiation exposure dose to the handling person.

[0008]

[Means for Solving the Problems]

The invention has solved the problems by presenting an injection method of radioactive liquid for injecting radioactive liquid into a human body, comprising the steps of holding the whole quantity of radioactive liquid temporarily in a radiation shielding liquid retainer immediately before injection, measuring the radiation dose of the radioactive liquid held in the liquid retainer, and injecting the whole quantity of the radioactive liquid into the human body.

[0009]

The invention has also solves the problems by presenting an injection apparatus of radioactive liquid for injecting radioactive liquid into a human body, comprising a liquid retainer for holding the whole quantity of radioactive liquid temporarily immediately before injection, radiation shielding means for shielding the liquid retainer, radiation measuring means for measuring the radiation dose of the radioactive liquid held in the liquid retainer, and liquid pushing means for injecting the whole quantity of the radioactive liquid after measurement of radiation dose into the human body.

[0010]

Further, the apparatus also comprises radiation shielding means for shielding the radioactive liquid pushing means for feeding the radioactive liquid into the liquid retainer.

[0011]

Moreover, all means are mounted on a movable carriage.

[0012]

[Embodiments of the Invention]

Referring now to the drawings, embodiments of the invention are specifically described below.

[0013]

A first embodiment corresponding to a basic configuration of the invention is shown in Fig. 1.

[0014]

This embodiment shows an injection apparatus comprising a bag 10 containing physiological saline or distilled water for injection, a tube 12 connecting the bag 10 at the rear end, disposing two three-way valves 14, 16 and a filter 18 sequentially from the bag 10 side in the middle, and connecting an injection needle 20 to the leading end, a pushing syringe 22 with servo actuator 24, for example, by ultrasonic motor for pushing in the physiological saline or distilled water for injection in the tube 12 by way of the three-way valve 14, and a radioactive medicine injection syringe 26 of servo actuator type by, for example, ultrasonic motor or manual type, contained, for example, in a lead shielding container 28 for injecting the radioactive liquid into the tube by way of the three-way valve 16, in which a coil-form medicine retainer 30 for temporarily holding the whole quantity of radioactive liquid immediately before injection, and a radioactivity measuring unit 32 having a display unit 34 for measuring the radiation dose of the radioactive medicine contained in the medicine retainer 30 are provided between the medicine injection syringe 26 and filter 18, and after measuring the radioactivity of the radioactive medicine contained in the medicine retainer 30 by the radioactivity measuring unit 32, the whole quantity of the radioactive medicine is injected into the subject by way of the pushing syringe 22.

[0015]

The medicine injection syringe 26 is contained in a shielding container 28 opened at the leading end (lower end in the diagram), and it is detachably provided in the apparatus in a state being accommodated in the shielding container 28. The medicine liquid in the medicine injection syringe 26 is entirely pushed into the tube 12, automatically or manually, by changeover of the valve 16, and the whole quantity is injected into the coil-form medicine retainer 30 provided in the middle of the tube 12. Further, the medicine liquid remaining at the inlet of valve 16 and coil-form medicine retainer 30 is pushed by the pushing syringe 22, and a specified quantity of distilled water for injection

or physiological saline is discharged, and the whole volume of medicine liquid is pushed into the medicine retainer 30.

[0016]

The medicine retainer 30 holds a coil capacity not allowing the medicine liquid to reach the subject when the whole quantity of medicine liquid is injected by the medicine injection cylinder 26.

[0017]

As the radioactivity measuring unit 32, a well type dose (radiation dose) calibrator is preferred in order to measure accurately. However, depending on the purpose, it is also effective to detect the value by rate meter or radiation counter by using NaI scintillation detector, GM detector, or other simplified detector.

[0018]

The action of the embodiment is explained below.

[0019]

After being installed in the apparatus, the medicine injection syringe 26 is lightly pushed in, and a precalculated volume is discharged, and the whole quantity of medicine liquid is pushed into the medicine retainer 30. Further, the medicine liquid remaining at the inlet of valve 16 and medicine retainer 30 is pushed by the pushing syringe 22, and a specified quantity of distilled water for injection or physiological saline is discharged, and the whole volume of medicine liquid is pushed into the medicine retainer 30.

[0020]

An injection needle 30 at the leading end of the tube 12 is attached to the subject.

[0021]

When completely ready for examination, an accurate radiation dose is measured by the radioactivity measuring unit 32, and the distilled water for injection or physiological saline is passed by the pushing syringe 22, and the whole quantity of the radioactive medicine held in the medicine retainer 30 is administered to the subject.

[0022]

After administration, preparation for next administration is started. At this time, since the whole quantity has been administered, unlike the prior art, it is not required to measure the remainder of radioactivity of the medicine injection syringe 26 used in administration.

[0023]

Next, a second embodiment suited to actual clinical use is specifically described below.

[0024]

This embodiment is shown in Fig. 2 (longitudinal sectional view seen from the front), Fig. 3 (lateral sectional view seen from the top), Fig. 4 (longitudinal sectional view seen from the right side in Fig. 2), and Fig. 5 (rear view of essential parts), and comprises, same as in the first embodiment, bag 10, tube 12, three-way valves 14, 16, filter 18, pushing syringe 22, medicine injection syringe 26, medicine retainer 30, and radioactivity measuring unit 32, which are all mounted on a wagon 40 furnished with a fixing caster 42, a free caster with brake 44, and a handle 46, so as to be moved easily within a hospital.

[0025]

In the drawings, reference numeral 50 is a stand for the bag 10 oscillatable in a range of arrow A shown in Fig. 3, 52 is a fixing stand for filter 10, 54 is a syringe holder for holding the pushing syringe 22, 56 is a syringe holder for holding the medicine injection syringe 26 having the leading end shielded by, for example, tungsten-made shielding container 28, 58 is a servo actuator for driving the medicine injection syringe 26 as indicated by arrow B in Fig. 3, 60 is a tube take-up pipe for composing the medicine retainer 30, 62 is a dose calibrator for composing the radioactivity measuring unit 32, 64 is its shield, 66 is a controller of the dose calibrator 62 having the panel fixed to the rear side in Fig. 2, 68 is a panel drawer type operation panel to be drawn as shown by arrow C in Fig. 3, provided similarly at the rear side of Fig. 2, 70 is a main control panel disposed beneath the wagon 40, 72 is a sub control panel provided above the main control panel 70, 74 is a lead shield of thickness of, for example, 20 mm having a lead upper lid 76 of thickness of, for example, 10 mm, slidable in the horizontal direction as indicated by arrow D, in order to shield the tube 12, three-way valves 14, 16, filter 18, and medicine injection syringe 26 mounted on the wagon 40, 78 is a radiation sensor provided at the exit side of the tube 12 for checking passing of radioactive medicine, 80 is a bottle for discharge liquid, 82 is its holder, 84 is a case for holding the pushing syringe 22, 86 is a transparent vinyl chloride door, and 88 is a buffer liquid disposal stand.

[0026]

In actual use of the embodiment, first of all, the medicine injection syringe 26 containing the radioactive medicine is set by opening the upper door 76 of the slidable lead shield 74.

[0027]

After shielding completely by closing the upper door 76, the servo actuator 58 is driven,

and the whole quantity of the radioactive medicine is sent into the medicine retainer 30 taken up on the tube take-up pipe 60. Further, the medicine liquid remaining at the inlet of valve 16 and coil-form medicine retainer 30 is pushed by the pushing syringe 22, and a specified quantity of distilled water for injection or physiological saline is discharged, and the whole volume of medicine liquid is pushed into the medicine retainer 30.

[0028]

The pipe 60 is lowered as indicated by arrow E, and put into the dose calibrator 62, and the radiation dose is measured.

[0029]

After measurement of radiation dose, the radioactive medicine is forced out (flushed) by the pushing syringe 22 driven by the servo actuator 24, and the whole quantity is sent into the subject.

[0030]

In this embodiment, at this time, passing of radioactive medicine is confirmed by the radiation sensor 78. This radiation sensor 78 may be also omitted.

[0031]

In the embodiment, since the operation is automated and the passing portion of the radioactive medicine is almost completely shielded, the exposure dose decreasing effect is very high, and in particular, since sterilized and disposable materials can be used in liquid end parts such as filter, tube, three-way valve, and syringe, aseptic operation can be easily maintained, and the lines can be exchanged easily.

[0032]

In radioactive medicines which are not short-life, necessity of exposure prevention is not so high, and accurate measurement is not difficult, but it is evident that the invention can be also applied.

[0033]

[Effects of the Invention]

According to the invention, the radiation exposure of the handling person can be lowered, and the administration dose can be measured easily and accurately.

[Brief Description of the Drawings]

Fig. 1 is a block diagram of first embodiment showing a basic configuration of the invention.

Fig. 2 is a longitudinal sectional view seen from the front, showing a second embodiment as a specific example of configuration of the invention.

Fig. 3 is a lateral sectional view of the same seen from the top.

Fig. 4 is a longitudinal sectional view of the same seen from the right side.

Fig. 5 is a rear view of essential parts of the same.

[Reference Numerals]

10 ···· Bag

12 ···· Tube

14, 16 · Three-way valve

18 ···· Filter

20 ···· Injection needle

22 ···· Pushing syringe

26 ···· Radioactive medicine injection syringe

30 ···· Medicine retainer

32 ···· Radioactivity measuring unit

40 ···· Wagon

60 ···· Tube take-up pipe

62 ···· Dose calibrator

28, 64, 74, 76 ·· Shield

Fig. 1

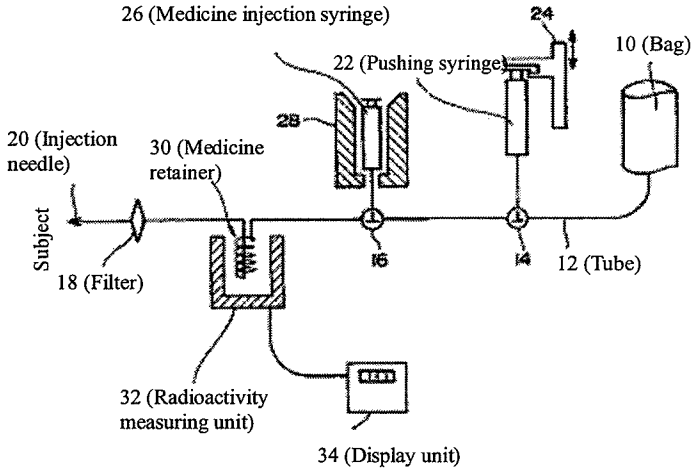
26 (Medicine injection syringe)
24
10 (Bag)
22 (Pushing syringe)
28
20 (Injection needle)
30 (Medicine retainer)
Subject
18 (Filter)
16
14
12 (Tube)
32 (Radioactivity measuring unit)
34 (Display unit)

Fig. 2

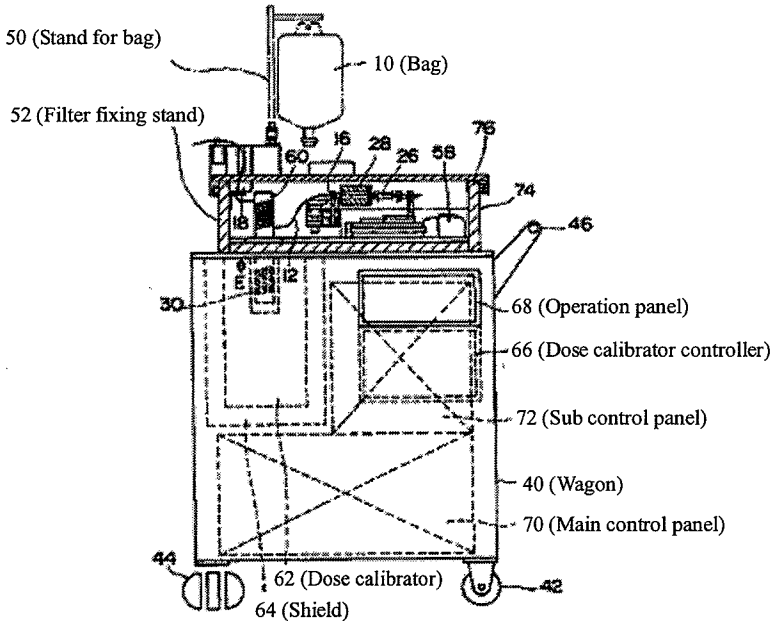
50 (Stand for bag)
10 (Bag)
52 (Filter fixing stand)
16
28
26
58
76
60
74
18
46
12
30
68 (Operation panel)
66 (Dose calibrator controller)
72 (Sub control panel)
40 (Wagon)
70 (Main control panel)
44
62 (Dose calibrator)
64 (Shield)
42

Fig. 3

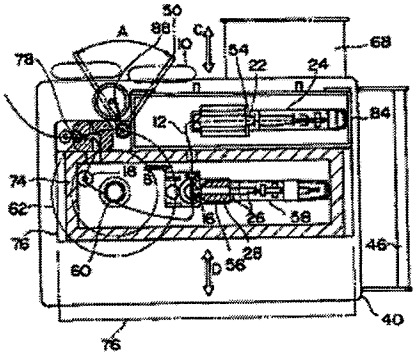

Fig. 4

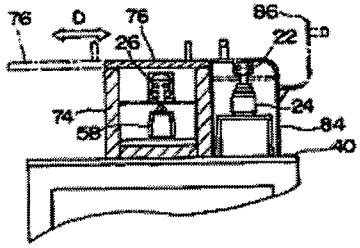

Fig. 5